

**INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
NONRULE POLICY DOCUMENT**

Title:	Development of a Site-Specific Metals Translator
Identification Number:	Water - 004 - NRD
Date Originally Adopted:	
Dates Revised:	None
Other Policies Repealed or Amended:	None
Brief Description of Subject Matter:	Procedure and Guidance to Develop a Site-Specific Metals Translator
Citations Affected:	327 IAC 5-2-11.1(d)(2), 327 IAC 5-2-11.6(c)(2)

This nonrule policy document is intended solely as guidance and does not have the effect of a law or represent formal Indiana Department of Environmental Management (IDEM) decisions or final actions. This nonrule policy document shall be used in conjunction with the applicable laws. It does not replace applicable laws, and if this policy conflicts with the laws, the laws shall control. This nonrule policy document may be put into effect by IDEM thirty days after presentation to the appropriate board and after it is made available for public inspection and comment, pursuant to IC 13-14-1-11.5. If the nonrule policy is presented to more than one board, it will be effective thirty days after presentation to the last. IDEM will submit the policy to the Indiana Register for publication. Revisions to this nonrule policy document will follow the same procedure of presentation to the board and publication.

This nonrule policy document provides procedures for the development of site-specific metals translators to be used in developing total recoverable metal water quality-based effluent limitations based on dissolved aquatic life water quality criteria (WQC) for a metal.

Outside the Great Lakes system, the aquatic life WQC for metals are expressed in terms of the acid-soluble fraction of the metal. However, since an analytical method that measures the acid-soluble fraction of the metal has never been approved, the rules require that the criteria be enforced in terms of the total recoverable fraction of the metal. Therefore, the water quality-based effluent limitations that are developed to comply with these WQC must be expressed in terms of the total recoverable fraction of the metal. However, under 327 IAC 5-2-11.1(d)(2), a specific permittee may request a site-specific metals translator, a ratio of the soluble or dissolved metal (DM) fraction to the total recoverable metal (TRM) fraction. This site-specific metals translator could be used to calculate water quality-based national pollutant discharge elimination system (NPDES) effluent limitations for a metal that may be higher than those calculated without a metals translator.

Inside the Great Lakes system, aquatic life WQC for metals are expressed in terms of the dissolved fraction of the metal. Water quality-based effluent limitations derived from water quality criteria must be expressed in terms of the total recoverable fraction of the metal in NPDES permits. Under 327 IAC 5-2-11.6(c)(2)(A) default metals translators are specified. Under 327 IAC 5-2-11.6(c)(2)(B), a discharger may request the use of an alternate metals translator using site-specific data. The discharger must conduct a site-specific study to identify the ratio of the dissolved fraction of the metal to the total recoverable fraction of the metal in the receiving water body (site-specific metals translator). If the discharger provides an acceptable study, and the other provisions of the rules are satisfied (such as antibacksliding and antidegradation), the site-specific metals translator shall be used in the development of the discharger's permit limitations. A site-specific metals translator derived for one discharge into a water body segment may be applied to other discharges on the same water body segment if the metals translator would accurately represent the site-specific conditions applicable to the other discharges.

<i>Author</i>	:	<i>Dr. Syed M. GhiasUddin, Chief, Toxicology/Chemistry/TMDL Section</i>
<i>Peer Review Committee</i>	:	<i>Jon Mangles, Chief, Permits Branch Dennis Clark, Chief, Water Quality Section Lonnie Brumfield, Senior Consultant, Permits Branch Steve Roush, Chief, Industrial Permits Branch John Elliott, Environmental Engineer, Modeling Section John Nixon, Office of Legal Counsel</i>

TABLE OF CONTENTS

	<u>Page</u>
I. Background	4
A. General Overview	4
B. Water Quality Criteria Conversion Factors	4
C. Metals Translators	6
II. Procedures for the Development of Metals Translators	6
A. Purpose	6
B. Definition of the Metals Translator	6
C. Methods for the Development of Site-Specific Metals Translator	7
III. Sampling and Analytical Procedures	7
A. General Overview of Sampling and Preservation Procedures	8
1. Collection of Receiving Water Samples	8
2. Collection of Whole Effluent Samples	9
3. Preparation of Simulated Downstream Water	9
4. Duration and Frequency of Sample Collection	9
5. Sample Preservation	10
B. General Overview of Analytical Procedures	10
1. Chemical Analysis for Metals	11
2. Analysis for Conventional Chemistries and Inorganic Parameters	11
C. General Overview of QA/QC Procedures	12
1. Precision and Accuracy	13
2. Equipment and Field Blanks	13
IV. Metals Translator Calculations	13
A. Dissolved to Total Recoverable Metal Ratio Method	13
B. Site-Specific Partition Coefficient (K _p) Method	13
C. General Requirements for Calculation of a Site-Specific Metals Translator	14
V. Use of a Site-Specific Metals Translator and Calculation of NPDES Permit Limits	15
VI. Metals Translator Study Report	15
VII. Bibliography	17

Tables

Table 1: Conversion Factors for Converting Freshwater Aquatic Life Total Recoverable Metal Water Quality Criteria to Dissolved Metal Water Quality Criteria	5
--	---

Table 2: Test Methods, Method Detection Limits (MDLs) and Limit of Quantitation	
--	--

(LOQ) or Minimum Levels (MLs) For Metals Analyses	12
---	----

POLICY

I. BACKGROUND

A. General Overview

The primary mechanism of metals toxicity to fish and other aquatic organisms in the water column is by absorption and uptake of metals across the gills or the general body surface. Essentially, this mechanism requires a metal to be in dissolved form. However, in the aquatic environment, a significant portion of most metals is bound or adsorbed to one or more metal binding sites (for example, total suspended solids (TSS), total dissolved solids (TDS), total organic carbon (TOC), particulate organic carbon (POC) or humic substances). Therefore, in the aquatic environment, a significant portion of the total recoverable metal (TRM) will not be bioavailable to aquatic life and will exhibit less toxicity than does the same concentration of the dissolved metal (DM).

In 1993, the United States Environmental Protection Agency (U.S. EPA) issued a new policy (see EPA 1993). According to this policy, “the use of dissolved metal to set and measure compliance with water quality standards is the recommended approach because the dissolved metal more closely approximates the bioavailable fraction of metal in the water column than does the total recoverable metal.”

In the rules for the Great Lakes system that were adopted by Indiana in 1997, the water quality criteria (WQC) for metals are expressed in the dissolved form. In the rules applicable outside the Great Lakes system that were adopted by Indiana in 1990, the WQC are not expressed in the dissolved form. However, the rules do allow for the water quality-based NPDES effluent limitations to be adjusted to take into account the difference between the dissolved and total recoverable form of a metal.

B. Water Quality Criteria Conversion Factors

Under the Clean Water ACT (CWA) of 1977, Section 304 (a), when the aquatic toxicity tests were originally conducted to develop the aquatic life water quality criteria for metals, metal concentrations were expressed as TRM. More recently, the U.S. EPA has re-evaluated the aquatic toxicity tests for the purpose of determining the percentage of TRM that was present as DM in the test solutions. This percentage is called the conversion factor and is used to reduce the TRM WQC to dissolved metal WQC. The conversion factors developed by the U.S. EPA for use with the freshwater WQC are listed in Table 1.

In the Great Lakes system, the conversion factors are used to reduce TRM WQC to dissolved metal WQC so that the WQC are expressed as the dissolved fraction of the metal. Outside the Great Lakes system, the WQC for metals are expressed as the acid-soluble fraction of the metal. However, since an acid soluble analytical method has not been approved, the metals aquatic life WQC are enforced as the total recoverable fraction of the metal. Therefore, unless a site-specific metals translator is

developed, metals conversion factors are not used with WQC for outside the Great Lakes system.

Table 1 Conversion Factors for Converting Freshwater Aquatic Life Total Recoverable Metal Water Quality Criteria to Dissolved Metal Water Quality Criteria¹		
Metal	Acute Criteria	Chronic Criteria
Arsenic (III)	1.000	1.000
Cadmium (Hardness 100)	$1.136672 - [\ln(\text{hardness}) * 0.041838]$ 0.944	$1.101672 - [\ln(\text{hardness}) * 0.041838]$ 0.909
Chromium III	0.316	0.860
Chromium (VI) ²	0.982	0.962
Copper	0.960	0.960
Lead (Hardness 100)	$1.46203 - [\ln(\text{hardness}) * 0.145712]$ 0.791	$1.46203 - [\ln(\text{hardness}) * 0.145712]$ 0.791
Mercury ³	0.850	0.850
Nickel	0.998	0.997
Selenium	0.922	0.922
Silver	0.850	-
Zinc	0.978	0.986
¹ EPA 1995a; EPA 1995b "Great Lakes Water Quality Guidance"; EPA 1999, "National Recommended Water Quality Criteria - Correction"; and IDEM 2000 ² The metals translator procedures discussed in this document are not applicable to chromium VI.. ³ The most stringent water quality criteria for mercury in 327 IAC 2-1-6 (12 ng/L) and 327 IAC 2-1.5-8(1.3 ng/L) are based on protection of human health and wildlife and not on protection of aquatic life from toxic effects. Therefore, the metals translator procedures discussed in this document are not applicable to mercury.		

C. Metals Translators

State and federal rules and regulations require that NPDES permit limitations be expressed in terms of the total recoverable fraction of the metal¹. Therefore, in the development of water quality-based effluent limitations, if a water quality criterion is expressed as the dissolved fraction of the metal, the dissolved fraction of the metal in the water column downstream of the discharge must be translated to the total recoverable fraction of the metal in the effluent. To accomplish this, a dissolved metal criterion is divided by the metals translator to produce a total recoverable metal criterion. The total recoverable metal criterion is then used in the calculation of water quality-based effluent limitations.

Inside the Great Lakes system, the rules specify to use the reciprocal of the metals conversion factors as the default metals translators to convert the dissolved fraction of the metal into a total recoverable fraction unless site-specific metals translators are developed and approved by IDEM. Outside the Great Lakes system, the rules allow the use of a site-specific metals translator in conjunction with the metal conversion factors as specified in Table 1.

II. PROCEDURES FOR THE DEVELOPMENT OF METALS TRANSLATORS

A. Purpose

This nonrule policy document contains procedures for the development of site-specific metals translators that would be used in conjunction with the appropriate metal conversion factors contained in Table 1 to derive total recoverable NPDES permit limitations.

B. Definition of the Metals Translator

A metals translator (F_D), is the fraction of the total recoverable metal concentration in site water (receiving water or whole effluent) that is present as dissolved metal and is expressed as a ratio between the dissolved (C_D) and total (C_T) recoverable metal concentration as shown below:

1

In an effluent, a metal that is bound or adsorbed to one or more metal binding sites may become dissolved and bioavailable once released into the ambient waters. This is the basis for the requirement that NPDES permit limitations be expressed in terms of the total recoverable form of the metal even though the water quality criterion for the metal may be expressed in the dissolved form.

$$F_D = C_D / C_T$$

Where:

C_D = Dissolved metal concentration

C_T = Total recoverable metal concentration

F_D = Dissolved fraction (translator)

C. Methods for the Development of Site-Specific Metals Translator

This nonrule policy document identifies two methods by which a metals translator can be developed: one by dissolved metal to total recoverable ratio method, and another by site-specific partition coefficient (K_p) method. The dissolved metal to total recoverable metal method is the simplest and involves measuring the total recoverable and dissolved metal concentrations in the site water. The site-specific partition coefficient method is more complex and involves the following steps:

1. Measuring metal concentrations (both total and dissolved) in the receiving water as a function of metal binding sites or adsorbent concentrations (TSS, POC, humic substances etc.);
2. Developing a metal partition coefficient (K_p) using the site-specific chemistry data; and
3. Developing the metals translator using one or more of the empirical equations (using the site-specific partition coefficient (K_p) and site-specific chemistry data).

Due to the expense and complexity that may be involved in the development of site-specific metals translators, a discharger is strongly recommended to prepare and submit a detailed study plan to IDEM, OWQ Permits Branch for approval before starting the study. This study plan should include the details and procedures for field sampling of receiving waters and whole effluent, chemical analytical techniques, data collection and statistical analysis, and finally the application of the site-specific metals translators. The activities that IDEM considers to be necessary for the development and implementation of the site-specific metals translator (and that need to be addressed in the study plan) are discussed in this document.

III. SAMPLING AND ANALYTICAL PROCEDURES

Appropriate and adequate sampling of the receiving water and the whole effluent is required for the development of site-specific metals translators. It is essential that, while sampling the receiving water and the whole effluent, both spatial and temporal variability be considered.

For sampling the receiving waters and the whole effluent and their analyses for dissolved and total

metal, use of both the clean sampling and ultra-clean analytical techniques are strongly recommended and may, in some circumstances, be necessary. In any case, special attention must be given to the choice of analytical methods. At a minimum, the discharger should evaluate the analytical methods that are capable of achieving extremely low detection levels for dissolved and total metals that are referenced in “The Metals Translator” guidance document from EPA (see EPA 1996a, 823-B-96-007, June 1996) and in EPA “Method 1669” on Clean Sampling Techniques (see EPA 1996b, 821-R-96-008, January 1996).

A. General Overview of Sampling and Preservation Procedures

Depending on the site, water samples need to be collected from upstream and downstream of the discharge and from the whole effluent.

1. Collection of Receiving Water Samples

Under Indiana’s rules (327 IAC 5-2-11.1(d)(2) and 327 IAC 5-2-11.6(c)(2)(B)) for developing a metals translator, ambient water samples must be collected downstream of the discharge after mixing with the receiving stream. This is essential because such sampling takes into account conditions in the water body that may result in changing the bound non-toxic metal to a dissolved toxic metal. The specific downstream sampling location will be identified in the work plan. The downstream sampling shall be conducted in the water body even if there is no upstream flow (such as for lake discharges or for discharges to streams that have a $Q_{7,10}$ of 0 cfs).

In addition to the downstream water sampling, sampling for total and dissolved metal should also be conducted in the receiving water body upstream of the discharge point, if there is any upstream flow. These data will be used to determine the ambient dissolved and total metal concentrations in the water body that are necessary for the determination of water quality-based effluent limitations.

Additionally, the sampling schedule should be adequate and take into consideration the following:

- Water samples should be collected during periods of typical operation, particularly with respect to operations that affect the total suspended solids (TSS) or the concentrations of total and dissolved metals being measured.
- Rivers and streams should be sampled under stable flow conditions which are not being influenced by precipitation events.
- For lakes and reservoirs, hydrologic considerations are not that important, as long as the sampling location remains unaffected by precipitation events.

2. Collection of Whole Effluent Samples

In addition to the receiving water samples, whole effluent samples (that is, end-of-pipe samples) must also be collected. All effluent samples must be collected just prior to discharge. Effluent samples must be taken in such a manner that the range of expected total and dissolved metal concentration variability in the effluent is captured.

3. Preparation of Simulated Downstream Water

In instances in which the dilution provided by the receiving water body is very large, (that is, greater than a 100:1 ratio of receiving stream flow to discharge flow) and would result in very low concentrations of the metal downstream, it may be appropriate to conduct analyses of simulated downstream water (SDSW) in addition to the analyses of the receiving water and the whole effluent. SDSW is made by mixing whole effluent water with receiving water that is collected upstream of the discharge (for lakes and reservoirs, outside of the influence of the discharge). These samples need to be mixed in proportion to the dilution that is likely to occur in the receiving water body. In instances when the dilution provided by the receiving water body results in very high dilution of effluent and very low levels of metal concentrations that are below the limit of quantitation (LOQ) or minimum level (ML) for the analytical test methods, mixing of the receiving water and whole effluent in other dilution ratios (for example, 30:1; 10:1 or 5:1), would also be acceptable. In either case, the SDSW would then be analyzed for dissolved and total recoverable metal to gather data to develop the metals translator.

$$\text{LOQ or ML} = \text{MDL} \times 3.18 \text{ (MDL is the method detection limit).}$$

When preparing SDSW samples, the same number of samples and type of sample collection need to be done for both the whole effluent and receiving stream. Filtration of the effluent and receiving water mixture should be done within sixty (60) minutes of mixing to minimize the risk of changes to the dissolved to total recoverable metal concentration due to partitioning effects and adsorption to the sampling bottles.

4. Duration and Frequency of Sample Collection

For a site-specific study to develop a metals translator, samples from the receiving waters (rivers, streams, lakes and reservoirs) and from the whole effluent are expected to be collected over a period of time. Usually, to account for various changing conditions of the receiving waters and the whole effluent, sample collection is expected to last for several months to a year.

The sampling of the receiving water and the whole effluent should be designed to address both the spatial and temporal variability. At times, it will be necessary to collect the receiving water samples under conditions that are most likely to be representative of a “critical flow” or a “design flow” or simply under a broad range of flow conditions. Obviously, this will require sampling of the receiving waters for at least a few months and may be for 12 months or more. The one obvious reason for

such a sampling design is to have a broad range of total suspended solids (TSS) conditions to develop a metals translator that should be protective of aquatic life during the low flow or critical stream flow conditions.

The recommended frequency of sample collection from a receiving water body and the whole effluent is at least one sample per week (4-5 samples per month). It is expected that at this rate of sampling frequency, sample collection should continue so that at least 20 acceptable data sets for dissolved and total recoverable metals are generated. Another reason to recommend this sampling frequency is to achieve a higher confidence in the data collected and the metal translator developed from it.

5. Sample Preservation

All samples collected for the total recoverable and dissolved metal analyses shall be preserved in accordance with the procedures contained in “Standard Methods for the Examination of Water and Wastewater”, Eaton, A.D. et al. 1998, 20th Edition.

Samples collected for TRM analysis shall be preserved in the field with redistilled or ultra-pure nitric acid (HNO_3) to adjust the pH to < 2 . The temperature of the sample shall be maintained at 4°C until analyzed at the laboratory.

Field preservation is not necessary for water samples collected for dissolved metals (DM). DM samples need to be filtered (0.45 μg filters) in the field and cooled to 4°C before the samples are shipped to the laboratory.

B. General Overview of Analytical Procedures

For the development of a site-specific metals translator, it is important that the metal analyses be conducted at or above the limit of quantitation (LOQ) or minimum level (ML) for the metal that can be reliably achieved by the particular laboratory performing the analyses. This is important, since measurements below the LOQ may suffer from analytical variability that may affect the dissolved to total recoverable metal ratio. Therefore, the quantitation level will be the primary determining factor in choosing the analytical method to be used. Ideally, the detection level for a metal should be 5-10 times lower than the expected dissolved metal concentrations. A method capable of achieving ultra-low detection levels is necessary if the metal concentrations are expected to be less than 4 times higher than the detection level. This is especially true for metals such as cadmium, copper, selenium, and silver that have very low aquatic life water quality criteria. A more detailed discussion on the analytical method selection and detection levels for the metals is provided in Section 5 of the EPA guidance document on “The Metals Translator.” The reader should refer to this EPA document for further information (EPA 1996a).

1. Chemical Analysis for Metals

For DM and TRM analyses, it is recommended that Low Detection Level sensitive test methods, such as ICP/MS (Inductively Coupled Plasma/Mass Spectrometry) Test Method 200.8 (EPA 1994), be used.

As compared to the conventional 200 Series Test Methods (Atomic Absorption or Graphite Furnace Procedures), newly developed ICP/MS Method 1638 (EPA 1995c) and other low detection sensitive test methods for analysis at nanogram levels for many metals should be considered. The several test methods for many metals that have been identified by EPA in the EPA Method 1669 for sampling ambient waters for trace metals (EPA 1996b) are listed in this document in Table 2.

2. Analysis for Conventional Chemistries and Inorganic Parameters

All water samples (downstream receiving water after mixing, upstream water, simulated downstream water and the whole effluent) shall be analyzed for conventional chemistries (pH, temperature, hardness, alkalinity and conductivity). In addition, total suspended solids (TSS), total dissolved solids (TDS), total organic carbon (TOC), particulate organic carbon (POC), and dissolved organic carbon (DOC) shall be analyzed to evaluate if a relationship exists between the dissolved to total metal ratio (F_D) and the metal adsorbent concentration (EPA 1996a).

Table 2 Test Methods, Method Detection Limits (MDLs), and Limit of Quantitation (LOQ) or Minimum Levels (MLs) For Metals Analyses					
Metal	CAS Number	Test Method	Technique	Method Detection Limit (MDL), µg/L	Minimum Level (ML) µg/L
Antimony (Sb)	7440-36-0	1638	ICP/MS	0.0097	0.02
Antimony (Sb)	7440-36-0	1639	STGFAA	1.90	5.00
Arsenic (As)	7440-38-2	1632	HydroxideAA	0.002	0.005
Chromium-VI (Cr ⁺⁶)	7440-47-3	1636	Ion Chromatography	0.23	0.5
Chromium-III(Cr ⁺³)	1308-14-1	1639	STGFAA	0.10	0.2
Cadmium (Cd)	7440-43-9	1637	CC/STGFAA	0.0075	0.02
Cadmium (Cd)	7440-43-9	1638	ICP/MS	0.013	0.1
Cadmium (Cd)	7440-43-9	1639	STGFAA	0.023	0.05
Cadmium (Cd)	7440-43-9	1640	CC/ICP/MS	0.0024	0.01
Copper (Cu)	7440-50-8	1638	ICP/MS	0.087	0.2
Copper (Cu)	7440-50-8	1640	CC/ICP/MS	0.024	0.1
Lead (Pb)	7439-92-1	1637	CC/STGFAA	0.036	0.1
Lead (Pb)	7439-92-1	1638	ICP/MS	0.015	0.05
Lead (Pb)	7439-92-1	1640	CC/ICP/MS	0.0081	0.02
Nickel (Ni)	7440-02-0	1638	ICP/MS	0.33	1.0
Nickel (Ni)	7440-02-0	1639	STGFAA	0.65	2.0
Nickel (Ni)	7440-02-0	1640	CC/ICP/MS	0.029	0.1
Selenium (Se)	7782-49-2	1638	ICP/MS	0.45	1.0
Selenium (Se)	7782-49-2	1639	STGFAA	0.83	2.0
Silver (Ag)	7440-22-4	1638	ICP/MS	0.029	0.1
Thallium (Tl)	7440-28-0	1638	ICP/MS	0.0079	0.02
Zinc (Zn)	7440-66-6	1638	ICP/MS	0.14	0.5
Zinc (Zn)	7440-66-6	1639	STGFAA	0.14	0.5
Source: EPA 1995c; EPA 1996a; EPA 1996b (Method 1669). MDL determined by 40 CFR Part 136, Appendix B. ML (LOQ - Limit of Quantitation), calculated by multiplying MDL by 3.18.					

C. General Overview of QA/QC Procedures

For both sampling and analyses, appropriate quality assurance and quality control (QA/QC) procedures must be used. This will include collection of an adequate number of water samples, field equipment blanks, field duplicates and matrix spiked samples. A close watch on these and other QA/QC procedures will help to avoid excessive analytical variability and to establish precision and

accuracy in sampling and analysis.

1. Precision and Accuracy: Metal analysis precision will be judged from repeat analysis or laboratory spiked samples. A precision goal of $\pm 20\%$ relative percent difference (RPD) is expected to be met.

Metal analysis accuracy will be judged by comparison of percent (%) recovery from matrix spiked samples. An accuracy goal of 80-120% recovery is set for data acceptability for all metal analyses.

2. Equipment and Field Blanks: Non-contamination of equipment will be judged from equipment blank sample analyses. To accomplish this, equipment blanks (bottle blanks and sampling equipment blanks), field (trip) blanks collected prior to sample collection, lab calibration blanks and method blanks will be used to assess for any contamination (see EPA 1995a, "Guidance on the Documentation and Evaluation of Trace Metals Data Collected for Clean Water Act Compliance Monitoring").

IV. METALS TRANSLATOR CALCULATIONS

The metals translator (F_D) is expressed as the fraction of TRM present as DM in the receiving water and the whole effluent and will be calculated by either one of the two methods listed below:

A. Dissolved to Total Recoverable Metal Ratio Method

If the metals translator appears not to be dependent on any metal binding site or an adsorbent (for example, TSS or POC), the metals translator will be calculated by the DM to TRM ratio method using the following equation:

$$F_D = C_D / C_T \quad \text{Or} \quad F_D = (C_T / C_D)^{-1}$$

Where: F_D = Dissolved fraction (translator)
(Ratio for the fraction of total recoverable metal present as dissolved metal).

C_D = Dissolved metal concentration ($\mu\text{g/L}$).

C_T = Total recoverable metal concentration ($\mu\text{g/L}$).

B. Site-Specific Partition Coefficient (K_p) Method

If the metals translator appears to be dependent on any metal binding site or an adsorbent concentration, (for example, TSS or POC), the metals translator will be calculated by site-specific partition coefficient (K_p) method using the following 3 equations:

$$\begin{aligned}
1. \quad C_P &= C_T - C_D \\
2. \quad K_P^1 &= \frac{C_P}{(C_D)(TSS)} \quad \text{Or } K_P = C_P / (C_D * TSS) \\
3. \quad F_D &= \frac{1}{1 + (K_P)(TSS)} \quad \text{Or } F_D = (1 + (K_P * TSS))^{-1}
\end{aligned}$$

Where:

- C_P = Particulate fraction sorbed to metal binding site ($\mu\text{g/L}$).
- C_T = Total recoverable metal concentration ($\mu\text{g/L}$).
- C_D = Dissolved metal concentration ($\mu\text{g/L}$).
- K_P = Partition coefficient (L/Kg).
- TSS = Total suspended solids (mg/L).
- F_D = Translator (Ratio for the fraction of the TRM present as DM).

C. General Requirements for Calculation of a Site-Specific Metals Translator

To calculate a site-specific metals translator by either DM to TRM Ratio Method or Site-Specific Partition Coefficient (K_P) Method, the following requirements would apply:

1. A site-specific metals translator will be calculated separately for the downstream water or the SDSW.
2. A data pair will be considered valid only when both the TRM and DM concentrations are greater than the LOQ or ML. If the TRM or the DM concentration is less than the LOQ or ML (or non-detect), then the data pair will be considered invalid and will not be used in metals translator calculations. Also, a total metal value must be higher than a dissolved metal value to be considered a valid data pair.
3. A minimum of twenty (20) valid data pairs obtained over a period of four (4) to six (6) months or greater is expected to be utilized in the metals translator calculations.
4. In general, the most conservative site-specific metals translator (F_D) obtained from analysis of the downstream receiving water or SDSW that would result in the lowest WQC or WLA will be used as the final metals translator (F_D) in calculation of water quality-based effluent limitations.

¹ K_P can be obtained from least square or by linear regression analysis from the fraction $(C_T/C_D)-1$ as a function of adsorbent concentration (for example, TSS or POC). The slope of the curve will be the partition coefficient (K_P). This value will be used in equation 3 along with appropriate adsorbent concentration as representative of the critical conditions to calculate the metals translator.

V. USE OF A SITE-SPECIFIC METALS TRANSLATOR AND CALCULATION OF NPDES PERMIT LIMITS

A new total recoverable NPDES permit limit using an appropriate site-specific metals translator will be calculated for discharges inside and outside the Great Lakes system, as follows.

1. Multiply the acute and chronic aquatic life total recoverable metals water quality criteria (WQC) by the appropriate conversion factor from Table 1 to obtain the dissolved metal aquatic life WQC.
2. Divide the acute and chronic dissolved metal aquatic life WQC by the site-specific metals translator developed as discussed above to determine the total recoverable metals aquatic life WQC.
3. Use the adjusted acute and chronic total recoverable metals WQC to calculate the acute and chronic total recoverable metals wasteload allocations.
4. Use the acute and chronic total recoverable metals wasteload allocations in the calculation of water quality-based effluent limitations.

VI. METALS TRANSLATOR STUDY REPORT

A site-specific metals translator study report, at a minimum, must include the following:

- Name, location and description of the discharger.
- Name, location and telephone number of the analytical laboratory performing the water samples analyses for metals, conventional chemistries and other analyses or associated parameters
- A copy of the approved study plan or a protocol used for developing a metals translator. Reasons and explanations for any changes or deviations from the approved study plan.
- A detailed description of the site and facility with appropriate information related to effluent discharge flow and stream flow at the time of sample collection. The date and time when each of the receiving water (upstream and downstream water) samples and whole effluent samples were collected for analyses. All sample collection events must be supported by chain-of-

custody records.

- Metals translator study initiation and ending dates, and the total time duration water samples were collected for metals and other analysis.
- Data on conventional chemistries (pH, temperature, hardness, alkalinity and conductivity) of the receiving water and the whole effluent. In addition, information on analyses of TSS, TOC, DOC and POC and other relevant parameters must be gathered and included in the report.
- Data on each set of dissolved and TRM concentrations obtained from analyses of the receiving waters, SDSW and the whole effluent.
- Details about statistical analysis and statistical procedures or formulas used to analyze and interpret the metals analyses data to derive one or more metals translators.
- A detailed description on how a site-specific metals translator was derived.

VII. BIBLIOGRAPHY

- CWA 1977. The Clean Water Act of 1977. Public Law 92-500, as Amended, 33 U.S.C. 1251.
- Eaton, A.D. et.al. 1998.
Standard Methods for the Examination of Water and Wastewater, 20th Edition.
American Public Health Association, Washington, DC.
- EPA 1983. Method for Chemical Analysis of Water and Wastes. EPA 600/4-79/020, March 1983, Cincinnati, OH.
- EPA 1993. Office of Water, Memorandum (“Metals Policy”). “Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria,” October 1, 1993, Washington, DC.
- EPA 1994. Methods for the Determination of Metals in Environmental Samples. Supplement 1. EPA/600/R-94/111, May 1994, Washington, DC.
- EPA 1995a. Guidance on the Documentation and Evaluation of Trace Metals Data Collected for Clean Water Act Compliance Monitoring. EPA 821-B-95-002, Washington, DC.
- EPA 1995b. Great Lakes Water Quality Guidance. 60 FR 15366, 15391 (March 23, 1995).
- EPA 1995c. Method 1638: Determination of Trace Elements in Ambient Waters by Inductively Coupled Plasma-Mass Spectrometry. EPA 821-R-95-031, April 1995.
- EPA 1996a. The Metals Translator: Guidance for Calculating a Total Recoverable Permit Limit from a Dissolved Criterion. EPA 823-B-96-007, June 1996, Washington, DC.
- EPA 1996b. Method 1669: Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels. EPA 821-R-96-008, January 1996.
- EPA 1999. National Recommended Water Quality Criteria-Correction. EPA 822-Z-99-001, April 1999.
- FR 1994. FR = Federal Register, 40 CFR PART 122-EPA. Administered Permit Programs: The National Pollutant Discharge Elimination System. (122.45 (c)).
- IDEM 1996. Indiana Rules: Great Lakes Initiative (GLI) Water Quality Criteria for Protection of Aquatic Life and Human Health, Plus NPDES Permit Rules for the Great Lakes system. December 1996, Indianapolis, IN.
- IDEM 2000. Indiana Environmental Rules: Water. Indianapolis, IN.